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NATIONAL SYSTEM OF HIGHWAYS AND LANDSCAPE DESIGNING

ADDRESS

DELIVERED

BEFORE THE AMERICAN CIVIC ASSOCIATION
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CYRUS KEHR

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REPORTED BY MR. FLETCHER.

IN THE SENATE OF THE UNITED STATES,
March 9, 1916.

Resolved, That the manuscript submitted by the Senator from Tennessee (Mr. Shields) on January 13, 1916, entitled "A National System of Highways and Landscape Designing," being an address delivered before the American Civic Association, at Washington, D. C., on December 31, 1915, by Cyrus Kehr, of Knoxville, Tenn., be printed as a Senate document.

Attest:

JAMES M. BAKER, *Secretary.*

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NATIONAL SYSTEM OF HIGHWAYS AND LANDSCAPE DESIGNING.

Delivered before American Civic Association at Washington, D. C., December 31, 1915, by Cyrus Kehr, of Knoxville, Tenn.

The purpose of this address is to present a new factor in landscape designing, a factor which should receive attention prior to and as a basis for both "city planning" and "country planning."

With respect to utility, this factor is of prime and extreme importance for both national, civil, and military use.

As the reach of this new factor is nation wide, it may be said that the address relates to "nation planning."

A city plan can not be made complete without the previous designing of a group of main or trunk-line highways leading from surounding cities to the city being treated.

The factor of communication in a city plan must be related with communication between that city and other cities and towns or major centers of communication so geographically located as to make reciprocal communication from one to the other desirable or imperative.

In rural planning communication is also a prime factor, and must be treated simultaneously with other important factors and developed in relation with main lines of communication leading to distant places.

The national system of highways which is to be discussed is to provide communication between such major centers. Such system is to comprise the larger or dominating highways throughout the Nation. If ideal methods are to be pursued. the location and designing of all other highways must be subordinated to the highways of this national system, and the latter must be located and designed before other highways can be located and designed.

INCREASE IN RANGE OF COMMUNICATION.

The recent development of self-propelled vehicles adapted to travel faster than is possible with animal-drawn vehicles has made an increased demand for communication which is not relatively local but which connects towns and cities and other communication centers separated from each other 100 or 200 or more miles. In other words, it may be said that heretofore units of highway communication did not exceed courses extending from a county seat or other center in one county to a similar center in an adjoining county, while now such units of communication extend from a principal center in one State to another principal center in a distant part of the same State or in an adjoining State. In lieu of what may be termed State communication. there is now a demand for national communication. Effort should be made to so work out

this problem of national communication as to afford the most direct and convenient communication between neighboring major centers.

From the foregoing it becomes apparent that in civic improvement we must make room for a new branch of landscape designing, such branch comprising the location and designing of a national or Nation-wide system of highways affording such convenient and direct communication between all major centers throughout the Nation.

In this national system every highway extending from one major center to another should be regarded as complete in itself and as constituting a main or trunk line highway unit; and every such unit should bear its own distinctive name and be otherwise treated independently of other units. The name of every unit may be composed of the names of its two major centers, as, for example, Columbus-Indianapolis Highway may designate the unit connecting Columbus, Ohio, and Indianapolis, Ind.

The forming of this national plan will be, in a geographical sense, a large undertaking. But the principles involved do not differ essentially from the principles which must be recognized in working out a city or county or district plan.

HIGHWAY UNITS SERVE THROUGH AND LOCAL TRAFFIC.

At the outset, this one fact must be recognized, namely, that these trunk-line highway units will constitute lines of through communication between the centers which they connect and will also perform a very important part in local communication. In many local areas, these trunk-line highways, if they are properly located and designed and suitably connected with subordinate highways, will carry one-half, and in other localities as much as eight-tenths of the local traffic. The latter would usually be the case with portions of the trunk-line units which approach and enter their centers. At some such centers a half dozen units will enter, and for some distance out from the center they will lie near enough to each other to receive all local traffic to and from the center, either directly or after going short distances over auxiliary highways.

It is probable that at least three-fourths of all the highway traffic in the United States, outside of cities, can be put upon such a national system of highway units, while the remaining one-fourth of such traffic is scattered over a considerable mileage of auxiliary roads. The fact that these trunk-line units will carry large volumes of traffic makes it not only permissible but imperative to work out for every such unit the best possible location and grades and to put into it ample and substantial construction.

LOCATING MAJOR CENTERS.

The first step toward making this Nation plan must be to determine the major centers or focal points which are to be connected by means of trunk-line highway units. These centers must be selected with reference to present and prospective population and commerce and industrial development. Military considerations should also be taken into account, with a view to producing routes and centers for easy military movement and concentration. When choice for a center must be made between two places, preference should be given to the place which will best serve to group units.

DESIGNING TRUNK-LINE UNITS.

Each trunk-line unit must be so located and designed as to impart to it the greatest degree of continuity and directness. It is not meant by this that such unit must run in straight lines. Straight lines are frequently undesirable and positively objectionable. What is meant is that the course should be free from offsets and sharp angles and such short curves as will destroy the mental impression of continuity and as will make it difficult for the traveler to tell whether he is keeping the proper course at points where branch roads join the trunk line. The trunk-line unit should be so located and treated as to make it substantially unnecessary for the traveler to consult guide books or people while traversing the route. This might be accomplished in part by using a right of way and a roadbed wider than is given to other roads.

But while, as above stated, straight lines are frequently undesirable and positively objectionable, there should, nevertheless, be no variation from a straight line unless reason therefor will be apparent to the traveler. Wherever a straight course would preclude low grades or necessitate inexcusable cuts or fills there is ample reason for making curves; but such curves should be on as long radii as possible. A short curve should be used only when it is clearly impractical to use a long one. In such case the reason for the short curve is usually apparent to the traveler. Only obtuse angles are permissible, and any angle approaching or exceeding a right angle and any offset should be regarded as out of the question; and wherever possible a curve should be used instead of even an obtuse angle.

As an example of continuity, reference is made to the old National Highway constructed from east to west across the State of Ohio, the location having been made during the years 1825 and 1826. The act called for a straight line 80 feet wide, and this survey was so early in point of time that villages and towns afterwards grew along the highway, the latter forming a principal and direct street. This continuity or directness remains, although the highway went through periods of neglect and finally passed into the jurisdiction of the State. But if a traveler makes a tour eastward or westward across the northern portion of that State he finds a total absence of continuity of the course. The entire route is composed of local roads differing in character and joined to each other by angles and offsets, so that the traveler must constantly make inquiry to keep to the course.

Clearly, such a course is composed of a large number of highway fragments and can not be called a highway.

When the trunk line has been located by observing the limitations mentioned, an important condition will have been met, namely, giving to the traveler going over the unit from one of its centers the mental impression that he is not required to traverse unnecessary distance.

LOW GRADES.

Another factor in every trunk-line unit should be what are now regarded as low grades. The maximum grade should be 2½ per cent. Under the present stage of highway practice in this country that will appear to be a low maximum. It will be so by contrast, for

there are still many highway builders who regard 5 and 6 per cent as ordinary grades, and 7, 8, 9, and 10 per cent as permissible. But 2½ per cent is, in fact, not a low grade. In railroad work 2½ per cent is now excessive and impossible for trunk lines. It is only permissible in branches. In the earlier days of railroading, grades of 2, 3, and 4 per cent were thought permissible on trunk lines. But now it is considered almost imperative to keep within 1 per cent and very desirable to keep within one-half of 1 per cent. Of course, it is physically possible to operate trains over steeper grades, but the managements of railways endeavor to operate on business lines, and they have found that steep grades make operation expensive. There is economy in operating trains over low grades. This is a matter of dollars and cents, or, we may say, hundreds of thousands and millions of dollars. It is economy to have one crew and its one engine haul the largest possible tonnage in a train, or to make the steam from a ton of coal haul the largest possible number of tons. There are railroads upon which freight trains are made up to be hauled by one engine on grades ranging as high as 1 per cent and helping engines are needed to go over places having an addition of only one-fourth of 1 per cent to the grade. Railroad companies have learned that there is economy in expending hundreds of thousands and even millions of dollars to make what might popularly be regarded as an unimportant grade reduction.

It remains for highway designers and builders and users to learn what railroad men have learned in this respect. The cost of hauling a ton of freight on a highway is an economic matter just as much as it is to haul a ton of freight on a railroad. Freight and passengers should be moved on highways at the lowest possible cost. Generally speaking, a load which a team can haul on a level road must be divided for hauling up a 5 per cent grade. There is also economy in low grades for the movement of an empty vehicle. If a loaded vehicle goes one way over a low grade road, it can return empty in much less time than would be required if the road had steep grades.

PENALTY OR TOLL FOR STEEP GRADES.

The cost of maintaining and operating an animal-drawn or a motor-driven vehicle for hauling freight on highways or streets averages as high as $3 per day. Steep grades may easily reduce the total efficiency of such a vehicle by one-half, counting the amount hauled per load, speed with and without the load, and durability of the equipment. Assuming that on a given trunk-line highway unit 5,000 vehicles operate per day and that their efficiency is thus reduced only one-third (instead of one-half), the total toll or penalty paid each day for the grades is $5,000, and for 300 working days of the year $1,500,000, which equals interest at 5 per cent on $30,000,000. This for only 1 unit.

Economy not only justifies but demands the low grades.

Notwithstanding all these facts, there are intelligent men who argue that grades ranging as high as 5 per cent and even more are not only permissible but desirable for travel or hauling by both classes of vehicles. Yet those men must admit that while ascending such grades the engines of automobiles and auto trucks consume excessive quantities of fuel and become heated, and we must assume

that if horses and mules could speak they would express a preference for a level course skirting along a hillside rather than for a course going over the hill. Furthermore, going down a steep grade with any vehicle is costly.

It is generally thought to be out of the question to provide low-grade highways in hilly or mountainous regions. But the contrary is the case. A study of this question reveals the fact that in such regions many of the steep roads are made so by obstinately locating them up one side of a hill and down the other side, or up one end of a ridge and along the backbone and then down the other end, when, in each case, a level or nearly level hillside or valley course is at hand. In some cases these level or low-grade courses are readily apparent, but in other cases they can be found only by careful study by persons having suitable ability, a peculiar creative skill resembling the skill of the sculptor. Men of similar ability specialize in railway location, some having the pioneer instinct to such extent as to regard construction distasteful drudgery.

Many mountain places thought to be hopelessly isolated may be connected with the outside world by level or low-grade highways, and mountain ranges may be crossed in this way at places where it has been supposed that they can be traversed only at distant gaps or passes. The writer has traced a route for a trunk-line highway across the Cumberland Mountains, all of which may be constructed within 2 per cent grade, while it had been supposed that the best passage feasible across those mountains must be by a highway many miles distant and having grades ranging from 5 to 10 per cent.

Among hills and mountains it is easier to provide low grades for a highway than for a railway, for the highway permits more and shorter curves.

CHOOSING COURSE WITH REFERENCE TO AUXILIARY HIGHWAYS.

When along any portion of the trunk-line unit there is opportunity to choose between two courses, preference should be given to the course to which local lines of communication may best be connected if there is difference in this respect.

ADOPTING LOCAL HIGHWAYS.

When we approach the task of connecting centers with a trunk-line highway unit, we shall at once be met with the suggestion and temptation to adopt and use such local highways as we find between said two centers. But there is grave danger in such suggestion and temptation. When such local roads have excessive grades and are on courses not adapted to the trunk-line unit, such local roads should be ignored. Reference might be made to such a unit having a length of more than 100 miles and 80 or 90 per cent of new location. But nearly all the old roads adjacent that trunk line will still be required for local traffic, so that there need be only small loss in this respect.

YIELDING TO LOCAL INTERESTS.

In determining the location of a trunk-line unit, local interests should be given consideration in only a subordinate way. Primarily, the route should be regarded as a means for relatively long-

distance travel. Requests and petitions from individuals and delegations that the route be diverted here and there to adapt it to private interests should be ignored.

DIVERTING COURSE TO REACH HISTORIC PLACES.

On account of sentiment there is strong temptation to locate highways to reach historic places. But these trunk-line highway units should not be diverted for such purpose at a sacrifice of grades and directness. Usually such places should be reached by branch lines.

COMBINING BEAUTY WITH UTILITY.

While in the location of such a trunk-line unit utility must control and easy hauling for freight and easy going for the traveler must be given first consideration, yet everything consistent with utility should be done to make the course attractive, pleasing, and inspiring to all who traverse the road. This should be recognized while working out location, and after the location has been completed construction and future treatment should be prosecuted with the same purpose in view.

In connection with location there is here an opportunity for landscape designing on a large scale. All the way along the course it should be sought to present unexpected and emphatic changes in landscape views. It should be sought to present the largest number of the best possible landscape pictures, so that traversing the road will, in this respect, be superior to visiting an art gallery. Some of these pictures should be at short range, while others cover ample distances, and in others there should be an emphasis of height or depth.

In many places proper grade and distance can be had by adopting either of two locations, one presenting ordinary scenery and the other some splendid picture. The latter should be chosen.

As is the case with streets in city planning, so, in locating such a trunk-line highway unit, it should be sought to bring different stages of the road into alignment with objectives. These may be a hill or a mountain, a building or a group of buildings, a tree or a group of trees, or a gap between hills or mountains.

In nearly all portions of the United States nature has lavishly provided material for this kind of designing. If this opportunity is properly appreciated, splendid results constituting immense assets for our country will follow. Failure in this respect will involve an enormous aggregate loss.

Both for utility and dignity, the right of way of the highway unit should be at least 100 feet wide, in order that at present and in the future there may be room for a roadway of ample width for easy travel in both directions and in order that cuts and fills may be freely treated without interfering with adjacent private lands and in order that there may be spaces at the sides of the roadway to be occupied by trees, shrubs, vines, and grass. Wherever there are spaces suitable for this purpose, trees, shrubs and vines already on the right of way should be protected, and there should be additional planting, care being exercised to select species best suited to

utility and art. In this way these highway units may be made practical lessons in forestry conservation and in beautification. This feature may be augmented by adding to the right of way small pieces or fragments of land which have special beauty on account of topography, water, and plant growth. Along the courses of these highways there may be many such fragments of land having a small stream, spring, or rocks, cliffs, trees, shrubs, and vines, constituting a case in which natural beauty is the predominating feature, and utility in the ordinary sense is nearly or altogether lacking. On account of such quality these places may be made very desirable adjuncts to such highways.

CONDUITS FOR ELECTRIC WIRES.

Conduits for electric wires placed in every highway unit will form a national system of such conduits, providing for a national system of underground telegraph and telephone wires, the highways being without poles excepting for lighting.

RESTING AND CAMPING PLACES.

As further adjuncts to these highways there must be places for resting and camping—places on which tourists may procure water and rest for a half hour or an hour or camp for a night or longer. The ordinary highway affords no such places. Usually the traveler may now stop and rest or camp only by encroaching or trespassing upon private lands. There are already regions where few such private places can be found, and owners will gradually exclude the public from their lands. Before lands become more valuable and before places suited to this purpose are denuded of trees and otherwise spoiled for this purpose, such places should, as far as possible, be acquired for the public. These places should be for the use of those who travel for pleasure or business and for those who haul farm products, merchandise, or other freight.

In some instances these rest or camp places may be added at one side or the other of the 100-foot right of way, and in other instances they may be put into the middle of the right of way, the roadway being divided and extended along both sides of the rest or camp place and the right of way being correspondingly widened.

Recently in the city of Ashland, Oreg., in a public park, camp lots were marked by suitable boundaries and the free use of these, including water and lights, granted to automobile tourists bringing their own tents.

LOCATING AND PLANNING AUXILIARY HIGHWAYS.

When any trunk-line unit has been located and designed, the plan therefor may be made the basis for locating and planning auxiliary highways leading to and properly connecting with the trunk-line unit and connecting minor centers in the same manner as the trunk-line unit connects major centers. In the designing and planning of these auxiliary highways, substantially the same principles should be followed as controlled in the location and designing of the trunk-line unit. Then still less important local highways may be planned

and connected with the trunk-line unit or the near-by auxiliary highways. In this manner the planning may be developed until the least important local roads are reached. At each stage of this development new opportunity is given for features of landscape designing in both direct and indirect association with the highways. And it will now be seen that all through this development the treatment of certain features of designing must await the treatment of some other feature; that practically all features which are not highways or directly associated with highways should await the location and designing of the highways and that the designing of the highways should be progressive, beginning with the trunk-line units. As soon as the trunk-line units in any given section of the country have been designed the designing of auxiliary and other roads in that section may be undertaken without waiting for the designing of all the trunk-line units throughout the United States; and even the construction of the auxiliary and local highways may be undertaken and completed before the plan for near-by trunk-line units has been executed.

SYSTEM OF UNITS AFFORDS NATIONAL COMMUNICATION.

When all these trunk-line units have been planned and built throughout the United States, the people of practically every congressional district in the Nation will have easy highway communication with practically all other portions of the United States; and any person desiring to make a long journey by highway can do so over an ideal highway either from his own door or after traveling only a short distance over an auxiliary highway, and practically every locality in the entire United States will have the benefit of travel from all other portions of the United States.

While, as already stated, every unit of the national system will bear its own name, consisting, preferably, of the names of the two major centers connected by said unit, any group of units arranged in series may be designated as a "route" connecting the major centers located at opposite ends of said group. For example, "Washington-Atlanta Route" may designate, collectively, the connecting trunk-line highway units forming the most direct course between Washington, D. C., and Atlanta.

LONG-DISTANCE SINGLE HIGHWAYS UNDESIRABLE.

Only such a national system composed of highway units will serve and be fair to all portions of the country, and such a system will render long-distance single-highway projects unnecessary. Such single projects are nonaltruistic, in that they aim to procure advantages to certain localities to the exclusion of other localities, and they are disappointing because the launching of every such project is followed by other similar projects leading through disappointed localities, or the single highway project is made to evolve or expand into a project for a system composed of units resembling those here suggested, in order to satisfy and obtain the cooperation of more people. Nearly every long-distance project has been thus expanded or amplified, and in some cases portions of these projects overlap two,

three, and four times. Thus exclusiveness, individuality, and identity of these projects are lost.

Nearly every such project has had its origin with some interested town, city, person, or business interest, and many have been the unseemly scrambles and contests for the location of such portions of such projects as were not fixed by the originators. Large numbers of people have traveled long distances and participated in prolonged and intense meetings with a view to winning what they deemed an important prize.

There is decided mutuality in this matter. It is to the interest of the people in any locality to have good communication provided for every other locality in the Nation. It is to the advantage of the people of every locality to have means of communication with every other locality in the Nation—for easy travel to every locality in the Nation and from every locality in the Nation. In this case the advantageous availing kind of selfishness is altruism.

If the development of highways extending throughout the Nation is left to local, disconnected, and interested initiative, the various projects will eventually, in a crude and wasteful way, approach a national system of highways resembling the system which I have suggested, just as a city which has grown from year to year through individual, interested, and disconnected initiative, in a general and crude way, approaches what that city should be. A city can be most economically planned while it is still in a formative state. Our Nation can be most economically and most successfully planned, if the task is undertaken and vigorously prosecuted before local and unrelated efforts proceed further.

INTEREST OF GOVERNMENT IN NATIONAL HIGHWAY SYSTEM.

Our National Government has a large interest in this matter of creating a national system of highways. On account of the post service, interstate commerce, irrigation projects, forest reserves, and national parks the interest of the Federal Government will be served by such a system of highways. Furthermore, no national military system can be complete without such a highway system. No program of "preparedness" for national defense will be complete unless it comprises a system of trunk-line highways adapted to rapid and easy movement and concentration of armies, army equipments, and supplies. The highway system which I have suggested can be adapted to meet military as well as civil requirements. In the execution of the plan for such a system, preference should be given to such units as will most probably be needed in military emergency. Recently it has been proposed to provide heavy, mobile coast-defense artillery adapted to be taken from place to place along the coasts. If that is to be done trunk-line highway units should be adapted as far as may be to that purpose and their construction begun. In other portions of the country other military considerations will probably call for the location and early construction of other such units.

No more important national public work for civil use can be undertaken. There can be no more important factor in "military preparedness." If this is made part of our national military pro-

gram, there will be no loss even if war does not come. Not so with battleships.

And is not this an amply large task for landscape designing?

Since, even in its civil relations, this national system of highways will be national in character and importance, it should be regarded as a system of national highways and constructed and maintained as such by the National Government.

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